

Cardiovascular diseases associated with *Helicobacter Pylori* infection – a case – control study in Cabinda

Doenças cardiovasculares associadas à infecção por *Helicobacter Pylori* – um estudo de caso-controle em Cabinda

Joao Filipe Camanda¹

Adalia Ikiroma²

Fernão Osório Afonso³

Shabani Kyabenga⁴

Abstract

Background: *Helicobacter pylori* (*H. pylori*) infection is increasingly recognized as a potential contributor to the pathogenesis of cardiovascular diseases, primarily through mechanisms involving chronic systemic inflammation, endothelial activation, and altered lipid metabolism. **Objectives:** To determine the epidemiological profile of the most common cardiovascular diseases associated with *H. pylori* infection and to identify the risk factors influencing this association in Cabinda. **Methods:** A descriptive and analytical case-control study was conducted among adult men and women with and without clinically and biologically confirmed cardiovascular disease. Data were obtained from clinical records and laboratory results at Cabinda Provincial Hospital. In

¹ PhD - Cancer and Sickle Cell Disease Epidemiologist
Head of the Center for Scientific Research and Development in Public Health - Lecturer in Public Health, University of 11 de Novembro Cabinda, Angola
<https://orcid.org/0000-0002-7888-5414>

² PhD - Honorary Research Fellow
Biostatistics and Health Data Science (BHDS) - University of Aberdeen, Scotland
United Kingdom

³ PhD - Director of Scientific Research, Innovation, Entrepreneurship, and Postgraduate Studies
Curriculum, Teaching Staff and Educational Institutions - fersorio@gmail.com

⁴ MSc - PhD Candidate in Microbiology - Postgraduate Training in Sickle Cell Anemia
Researcher and Lecturer, Faculty of Medicine - University 11 de Novembro.
Email: shabanikyab17@gmail.com
<https://orcid.org/0009-0003-9876-3435>

addition, biological samples were collected for *H. pylori* testing, including serological assays and fecal antigen detection, which were performed at the microbiology laboratory of FM-UON. **Results:** A total of 170 participants were included, comprising 85 individuals with cardiovascular disease (cases) and 85 without cardiovascular disease (controls). The prevalence of *H. pylori* infection was 81.2% among cases and 40.0% among controls. Chi-square analysis revealed a statistically significant association between *H. pylori* infection and cardiovascular disease ($\chi^2 = 28.48$; $p < 0.0001$). Individuals infected with *H. pylori* had significantly higher odds of developing cardiovascular disease (OR = 6.47; 95% CI: 3.23–12.97) compared with uninfected individuals. **Conclusion:** These findings indicate that *H. pylori* infection may represent an important risk factor for cardiovascular disease, potentially mediated through systemic inflammation and chronic immune activation. Further research, particularly interventional studies assessing the impact of *H. pylori* eradication on cardiovascular risk, is needed to better elucidate the causal nature of this association.

Keywords: *Helicobacter pylori*; cardiovascular disease; pathogenesis; Angola; Cabinda

Resumo

Introdução: A infecção por *Helicobacter pylori* (*H. pylori*) tem sido cada vez mais reconhecida como um possível fator contribuinte para a patogênese das doenças cardiovasculares, principalmente por meio de mecanismos relacionados à inflamação sistêmica crônica, à ativação endotelial e às alterações no metabolismo lipídico. **Objetivo:** Determinar o perfil epidemiológico das doenças cardiovasculares mais frequentes associadas à infecção por *H. pylori* e identificar os fatores de risco que influenciam essa associação em Cabinda. **Métodos:** Foi realizado um estudo descritivo e analítico, do tipo caso-controle, envolvendo homens e mulheres adultos, com e sem doença cardiovascular clinicamente e biologicamente confirmada. Os dados foram obtidos a partir de registros clínicos e resultados laboratoriais do Hospital Provincial de Cabinda. Além disso, foram coletadas amostras biológicas para investigação da infecção por *H. pylori*, incluindo testes sorológicos e detecção de antígeno fecal, realizados no laboratório de microbiologia da FM-UON. **Resultados:** Foram incluídos 170 participantes, sendo 85 indivíduos com doença cardiovascular (casos) e 85 sem doença cardiovascular (controles). A prevalência da infecção por *H. pylori* foi de 81,2%

entre os casos e de 40,0% entre os controles. A análise pelo teste do qui-quadrado revelou associação estatisticamente significativa entre a infecção por *H. pylori* e as doenças cardiovasculares ($\chi^2 = 28,48$; $p < 0,0001$). Os indivíduos infectados por *H. pylori* apresentaram chances significativamente maiores de desenvolver doença cardiovascular (OR = 6,47; IC 95%: 3,23–12,97) em comparação com os indivíduos não infectados. **Conclusão:** Os achados indicam que a infecção por *H. pylori* pode representar um importante fator de risco para doenças cardiovasculares, potencialmente mediado pela inflamação sistêmica e pela ativação imunológica crônica. São necessárias novas pesquisas, particularmente estudos intervencionais que avaliem o impacto da erradicação do *H. pylori* sobre o risco cardiovascular, a fim de esclarecer melhor a natureza causal dessa associação.

Palavras-chave: *Helicobacter pylori*; doenças cardiovasculares; patogênese; Angola; Cabinda.

INTRODUCTION

In recent years, scientific literature has increasingly highlighted a possible association between *Helicobacter pylori* (*H. pylori*) infection and cardiovascular diseases. Both conditions are chronic in nature and share overlapping pathophysiological mechanisms, particularly those involving inflammatory and immunological pathways ([Santos et al., 2023](#)).

H. pylori is a Gram-negative, microaerophilic bacterium that colonizes the human gastric epithelium ([Sharon et al., 2021](#)). It is estimated to infect approximately 4.4 billion people worldwide, making it the most prevalent chronic infection in humans ([Keikha & Karbalaee, 2022](#)). Transmission occurs primarily through oral-oral and fecal-oral routes, is more common in developing countries, and increases with age.

Although *H. pylori* infection can progress gastritis, peptic ulcer, and gastric cancer, most infected individuals remain asymptomatic, with only about 10% developing clinically significant disease ([Chmiela et al., 2015](#)). Infection is typically acquired during childhood, often through ingestion of contaminated water or food or through close interpersonal contact.

In the context of cardiovascular diseases, the early stages of atherosclerosis are characterized by endothelial dysfunction and the release of inflammatory cytokines, such as C-reactive protein (CRP), triggered by oxidative stress. These processes

contribute to disturbances in vascular homeostasis, dyslipidemia, increased production of vasoconstrictors, hemostatic abnormalities, and thrombus formation (He et al., 2014). Chronic inflammation induced by *H. pylori* infection may promote atherosclerotic plaque instability and contribute to extragastric manifestations. Persistent infection can also lead to dysregulation of multiple physiological systems, including excessive production of inflammatory mediators, hormonal alterations, and metabolic changes associated with *H. pylori* infection that have been linked to systemic hypertension (Mengyun et al., 2021). Furthermore, the sustained inflammatory response, driven by the recruitment of neutrophils and other immune cells to the gastric mucosa, may extend beyond the gastrointestinal tract and contribute to systemic inflammatory processes, including the development and progression of atherosclerosis (Choi et al., 2019).

Research Question

- What is the epidemiological profile of cardiovascular diseases associated with *H. pylori* infection?
- What are the risk factors influencing this association in Cabinda?

Objectives

General Objective

To determine the epidemiological profile, the association between *H. pylori* infection and cardiovascular diseases, and the specific factors influencing this association in Cabinda.

Specific Objectives

1. Test for *H. pylori* infection in individuals clinically and biologically diagnosed with cardiovascular disease and in those without cardiovascular disease.
2. Determine the epidemiological profile of *H. pylori* infections and the most common cardiovascular diseases in Cabinda.
3. Measure the risk factors influencing this association in Cabinda and potential impacts on the central nervous system.

II. MATERIALS AND METHODS

2.1 Materials

Study Site

Participants were recruited from Cabinda Provincial Hospital (HPC) and the microbiology laboratory of the Faculty of Medicine at the University of 11 de Novembro.

Study Population

The study population consisted of adult men and women clinically and biologically evaluated for cardiovascular disease and tested for *H. pylori* infection. Only individuals aged 18 years and above were eligible for inclusion.

Inclusion Criteria

General Inclusion Criteria

- Adults aged ≥ 18 years.
- Hospitalized at Cabinda Provincial Hospital or other healthcare facilities within Cabinda Province.
- Provided informed consent to participate in the study.
- Underwent clinical evaluation and biological testing relevant to cardiovascular disease and *H. pylori* infection.

Case Definition

- Adult patients (≥ 18 years) with a clinically and biologically confirmed diagnosis of cardiovascular disease.
- Diagnosis established through appropriate imaging or diagnostic procedures, such as echocardiography (ECHO), electrocardiogram (ECG), computed tomography (CT) scan, or other relevant investigations.

Control Definition

- Adults (≥ 18 years) with no history, symptoms, or clinical signs of cardiovascular disease.
- No documented cardiovascular pathology in medical records.

Exclusion criteria

Participants were excluded if they met any of the following conditions:

- Age under 18 years.
- Lack of informed consent from the participant.

- Withdrawal from the study or request for withdrawal at any stage.
- Recent antibiotic therapy within the past 30 days, which could interfere with *H. pylori* detection.
- Presence of active autoimmune diseases or malignancies, due to their potential impact on inflammatory markers.
- Documented infection with another pathogen capable of producing clinical or biological effects like *H. pylori*.
- Refusal of participation by a legally authorized representative or family member (when applicable).

Ethical considerations

Participation in the study was entirely voluntary. All eligible participants provided signed informed consent prior to enrollment. The study protocol received approval and deliberation from the Scientific Committee of the Cardiology Society during the 3rd Cardiology Conference in Cabinda (2024). Authorization for data collection was granted by the Provincial Health Secretariat. Confidentiality and anonymity of patient data were strictly maintained throughout the research process.

Study type

A descriptive and analytical case-control study was conducted to evaluate the association between *Helicobacter pylori* infection and cardiovascular disease.

Study duration

The study was conducted over a 9-month period:

- Inclusion phase: January to June 2025 (6 months)
- Data processing, statistical analysis, and manuscript preparation: July to September 2025 (3 months).

Principles and methods

Data collection was carried out through a documentary review of medical records from relevant departments at the HPC. Information was extracted from consultation registers, clinical files of hospitalized or monitored patients, and laboratory reports, including results from biological samples such as blood and stool.

A descriptive analytical case-control design was applied. Cases consisted of patients with clinically and biologically confirmed cardiovascular disease at the Cabinda

Provincial Hospital. Controls were adults without cardiovascular disease who underwent *H. pylori* testing at the microbiology laboratory the Faculty of Medicine at the 11 de Novembro University (FM-UON).

Data sources included:

- Medical records and clinical files
- Biochemical laboratory reports
- Serological and fecal antigen test results for *H. pylori*
- C-reactive protein (CRP) measurements

Preliminary analyses

1. Detection of *H. pylori*:

Serological test (anti-*H. pylori* IgG) for chronic exposure.

Fecal antigen test (BUZUD One Step test, cassette-type test) to detect active infection.

Determination of C-reactive protein (CRP).

Variables studied:

Sociodemographic data (gender, age, residence)

Clinical data: (reason for hospitalization or admission, clinical diagnosis, blood pressure)

Biological data:

Test for *H. pylori* infection;

Measurement of C-reactive protein (CRP).

Blood collection:

Venous blood was collected using a 5-ml EDTA blood tube for *H. pylori* serological testing, and stool samples were collected in a clean 50-ml container for *H. pylori* testing via the antigenic test.

Statistical Analysis

Data was processed and analyzed using SPSS version 27. Categorical variables were compared using the chi square test, and odds ratios (OR) with 95% confidence intervals (CI) were calculated to assess associations. A significance level of $p = 0.05$ was adopted for all statistical tests.

RESULTS

A total of 170 participants were included in the study, consisting of 85 individuals with cardiovascular disease (cases) and 85 without cardiovascular disease (controls). The results of the univariate, bivariate, and multivariate analyses are summarized in the following tables and described below.

Table I. Characteristics of sociodemographic and clinical qualitative variables

Patient variables	n=(85)		n=(85)	
by age	Patients with	%	Patients without	%
	cadiosculopathy		cadiosculopathy	
	(case))		(control)	
Classe A [18-36]	11	13	10	11,6
Classe B [37 – 57]	37	43,5	35	41,4
Classe C [58 -78]	37	43,5	40	47
Patient's gender				
Female	35	41,2	44	51,8
Male	50	58,8	41	48,2

Table I presents the distribution of sociodemographic variables among cases and controls. Most participants in both groups were in the middle aged and older adult categories. Among the case group, age classes B (37–57 years) and C (58–78 years) each accounted for 43.5%, while class A (18–36 years) represented 13%. A similar pattern was observed in the control group, where class C was the most represented (47%), followed by class B (41.4%) and class A (11.6%).

Regarding sex distribution, males predominated among cases (58.8%) over females (41.2%). However, females were slightly more frequent among controls (51.8%) compared to males (48.2%).

Table II. Clinical characteristics of qualitative variables regarding the reason for hospitalization

Variables Reason for admission	n=(85)	%
Preeclampsia	1	1.2
Abdominal pain	1	1.2
Stomach pain	1	1.2
Weakness	7	8.2
Left hemiplegia	1	1.2
High blood pressure	3	3.5
Heart failure	2	2.4
Involuntary movements	16	18.8
Impaired consciousness	12	14.1
Loss of speech	2	2.4
Fracture	1	1.2
Psychological agitation	2	2.4
Sudden fall to the ground	1	1.2
Seizure syndromes	1	1.2
Drowsiness	1	1.2

Thrombosis	1	1.2
Vertigo	2	2.4
Behavioral changes	2	2.4
Transient ischemic attack	1	1.2
Headache	2	2.4
Facial deviation	1	1.2
Diabetes	1	1.2
Decreased muscle strength	10	11.8
Respiratory distress	13	15.3
Total	85	100

A wide range of clinical manifestations were observed among patients with cardiovascular disease. The most common reasons for hospital admission are:

- Involuntary movements: 16 cases (18.8%)
- Respiratory distress: 13 cases (15.3%)
- Impaired consciousness: 12 cases (14.1%)
- Decreased muscle strength: 10 cases (11.8%)

Overall, the clinical profile of the case group demonstrated a predominance of neurological impairment, often accompanied by systemic manifestations such as respiratory distress, suggesting a complex and multifactorial presentation.

Table III. Clinical diagnostic characteristics

Variables Clinical diagnosis	n=(85)	%	
Type II diabetes	8	9,4	
Uncontrolled hypertension	1	1,2	
Hypertension	7	8,2	
Myocardial infarction	1	1,2	
Uncontrolled heart failure	5	5,9	
Cardiomyopathy	1	1,2	
Ischemic stroke	37	43,5	
Hemorrhagic stroke	15	17,6	
Myocardial constriction	1	1,2	
Type I diabetes	1	1,2	
Hypertensive encephalopathy	4	4,7	
Pericranial encephalopathy	2	2,4	
Chronic gastritis	2	2,4	

As shown in Table III, the most prevalent clinical diagnosis among cases was ischemic stroke, affecting 37 participants (43.5%). This was followed by hemorrhagic stroke, with 15 cases (17.6%). Among chronic non communicable diseases, type II diabetes mellitus accounted for 8 cases (9.4%), and hypertension for 7 (8.2%).

Table IV. Characteristics of microbiological parameters

Variables			H.pylori		H.pylori negativo		total
			positvo				
			Freq	%	Freq	%	
Cardiovascular	disease	patients	69	81,2	16	18,8	85
(case)							
Non-cardiovascular	disease	patients	34	40	51	60	85
(controls)							
Total			103		67		170

The χ^2 test shows a highly significant association ($p < 0.0001$) between *Helicobacter pylori* infection and the presence of heart disease. The odds ratio of 6.47 indicates that individuals infected with *H. pylori* are 6.5 times more likely to have heart disease than those not infected. The confidence interval (3.23–12.97) does not include the value 1, reinforcing that the association is statistically significant and robust.

Table V. Characteristics of biological parameters

CRP test in mg/L	n=(85) (case)	%	n=(85) (control)	%
No risk	11	12,9	58	68,2
Moderate risk	6	7,1	14	16,5
High risk	29	34,1	9	10,6
Very high risk	35	41,2	4	4,7
Severe risk	4	4,7	0	0

Table V summarizes the microbiological findings. A large majority of participants tested positive for *H. pylori*, corresponding to 70 individuals (82.4%), while 15 participants (17.6%) tested negative.

Regarding inflammatory status, based on C reactive protein (CRP) levels:

- Non risk category: 11 individuals (12.9%)
- High risk: 29 individuals (34.1%)
- Very high risk: 35 individuals (41.2%)

These results indicate that most participants exhibited elevated CRP levels, consistent with a heightened inflammatory state.

DISCUSSION

Analysis of the sociodemographic, clinical, and biological characteristics of the study population reveals a predominance of middle aged and older adults among cardiovascular patients. Individuals aged 37–57 years and 58–78 years each represented 43.5% of the case group, confirming the well-established trend that cardiovascular disease increases with age, particularly due to the decline in endothelial function, arterial stiffness, and the accumulation of metabolic comorbidities ([Tadic & Cuspidi, 2021](#)). The low proportion of young adults (18–36 years: 12.9%) corroborates the trend observed in several African and European studies, where the incidence of cardiovascular disease remains low before age 40, followed by a sharp rise thereafter ([Mensah et al., 2019](#)). A male predominance was observed among cases (58.8%) compared to females (41.2%). This gender imbalance is frequently reported in the literature, with showing a higher cardiovascular risk, potentially due to hormonal, behavioral, and metabolic factors ([Gerdtz & Regitz-Zagrosek, 2019](#)). However, the protective effect of estrogen diminishes after menopause, leading to a substantial increase in cardiovascular risk among older women ([Regitz-Zagrosek et al., 2020](#)).

These data suggest a higher concentration of adults and older adults in the sample, which is consistent with the epidemiological profile of cardiovascular diseases, whose prevalence increases with age. The low representation of young individuals may indicate a lower incidence or early diagnosis of heart disease in this age group. The higher proportion of men among the cases may reflect greater male susceptibility to heart disease, possibly related to hormonal, behavioral, and lifestyle factors. The more balanced sex distribution in the control group reinforces the idea that this gender disparity is disease specific rather than population wide.

The clinical presentations observed, particularly involuntary movements (18.8%), respiratory difficulties (15.3%), and decreased level of consciousness (14.1%), reflect the severity of neurological and systemic damage associated with acute cardiovascular complications. These manifestations are commonly linked to ischemic or hemorrhagic stroke, cardiac decompensation, or severe metabolic disorders ([Benjamin et al., 2019](#)).

From a diagnostic perspective, the high prevalence of stroke (61.1%) among cases aligns with global data from the World Health Organization ([WHO, 2023](#)), which identifies stroke as one of the leading causes of morbidity and mortality worldwide. The coexistence of type 2 diabetes mellitus (9.4%), hypertension (9.4%), and heart failure (5.9%) further highlights the central role of metabolic and hemodynamic comorbidities in cardiovascular diseases ([Cho et al., 2018](#)). These conditions interact through mechanisms involving hyperglycemia, oxidative stress, and endothelial dysfunction, and systemic inflammation, creating a vicious cycle that accelerates atherogenesis and vascular damage.

Inflammatory status, assessed through C-reactive protein (CRP), revealed that 75.5% of patients had high-risk levels. CRP is now recognized as an important biomarker of cardiovascular risk, independent of traditional lipid factors ([Ridker, 2021](#)). Elevated CRP reflects active systemic inflammation, which contributes to the progression of atherosclerosis, plaque rupture, and the occurrence of coronary or cerebrovascular events ([Libby, 2021](#)). These findings reinforce the growing understanding that cardiovascular disease is not solely a metabolic disorder but also a chronic inflammatory condition.

Overall, the results of this study underscore the complex interplay between age, sex, metabolic comorbidities, inflammatory processes, and clinical outcomes in cardiovascular disease. They also highlight the importance of integrating inflammatory markers and infectious agents like *H. pylori* into the broader framework of cardiovascular risk assessment.

IMPLICATIONS OF THE STUDY

The findings of this study underscore the significant role of systemic inflammation, reflected by elevated C reactive protein levels in the development and progression of cardiovascular disease. This highlights the importance of incorporating inflammatory

markers into routine cardiovascular risk assessment, alongside traditional metabolic and hemodynamic indicators.

The possible association between *H. pylori* infection and cardiovascular disease observed in this study further suggests that chronic infectious processes may contribute to cardiovascular risk. This relationship warrants deeper investigation through longitudinal studies and randomized clinical trials, particularly those evaluating the impact of *H. pylori* eradication on cardiovascular outcomes.

From a preventive perspective, the results emphasize the need to prioritize screening and early intervention among high-risk groups, especially middle aged and older adults with metabolic comorbidities. Finally, multicenter studies with larger and more diverse samples are recommended to validate these findings and enhance their generalizability.

CONCLUSION

The profiles identified in this study confirm that cardiovascular disease remains a major public health concern, particularly among middle aged and elderly men with elevated C reactive protein levels and metabolic comorbidities. Effective prevention requires early detection of risk factors, systematic monitoring of inflammatory markers, and the implementation of interventions aimed at reducing oxidative stress and chronic inflammation. The results also suggest that *H. pylori* infection may represent an important risk factor for cardiovascular disease, potentially mediated through systemic inflammatory pathways and chronic immune activation. Further research assessing the effect of *H. pylori* eradication on cardiovascular risk is essential to clarify the causal nature of this association.

Acknowledgments

We express our sincere gratitude to all individuals and institutions who contributed to the development and completion of this study. Their support, collaboration, and commitment were invaluable to the successful production of this work.

Funding

This work was fully supported by internal funding provided by the Center for Scientific Research and Development in Public Health, of the Faculty of Medicine at the University of 11 de Novembro. No external funding was received for this study.

Conflict of Interest

The authors declare that there is no conflict of interest related to this study. All authors actively participated in the development, analysis, and completion of this manuscript.

Authors' Contributions

SK designed the study and wrote the first draft of the manuscript.

CJF supervised the study and gave final approval of the manuscript.

JFC and SK participated in and contributed to data collection, analysis, and discussion of the findings.

AI conducted the review of the final version of the manuscript for publication.

All authors read and approved the final version of the manuscript.

REFERENCES

Sharon, N., Shapira, I., & Rogowski, O. (2021). Helicobacter pylori infection and cardiovascular disease: Current perspectives. *World Journal of Gastroenterology*, 27(35), 5938–5950. <https://doi.org/10.3748/wjg.v27.i35.5938>.

Sharon, N., Shapira, I., & Rogowski, O. (2021). Helicobacter pylori infection and cardiovascular diseases: Current perspectives *World Journal of Gastroenterology*, 27(35), 5938-5950 , <https://doi.org/10.3748/wig.v27.i35.5938>

Keikha, M., & Karbalaie, M. (2022). Association of Helicobacter pylori infection with cardiovascular diseases: A systematic review and meta-analysis. *Microbial Pathogenesis*, 163, 105380. <https://doi.org/10.1016/j.micpath.2022.105380>.

Chmiela, M., Gonciarz, W., & Rudnicka, K. (2015). Helicobacter pylori and its role in cardiovascular diseases. *Postępy Higieny i Medycyny Doświadczalnej*, 69, 1139–1148. <https://doi.org/10.5604/17322693.1173922>.

He, C., Yang, Z., & Lu, N. (2014). Helicobacter pylori infection and atherosclerosis: Is there a link? *World Journal of Cardiology*, 6(5), 338–344. <https://doi.org/10.4330/wjc.v6.i5.338>.

Meng, X., Zhang, G., & Cao, Q. (2021). Helicobacter pylori infection and risk of cardiovascular disease: A meta-analysis. *European Journal of Preventive Cardiology*, 28(9), 1021–1030. <https://doi.org/10.1177/2047487320903635>.

- Choi, Y. J., Kim, N., & Lee, J. Y. (2019). *Helicobacter pylori* infection and cardiovascular risk factors in asymptomatic adults. *Gut and Liver*, 13(6), 639–647. <https://doi.org/10.5009/gnl18412>.
- Tadić, M., & Cuspidi, C. (2021). *Helicobacter pylori* and cardiovascular diseases: A review. *Journal of Clinical Medicine*, 10(17), 3866. <https://doi.org/10.3390/jcm10173866>.
- Mensah, G. A., Roth, G. A., & Fuster, V. (2019). The global burden of cardiovascular diseases and risk factors. *Journal of the American College of Cardiology*, 74(20), 2529–2532. <https://doi.org/10.1016/j.jacc.2019.10.009>
- Gerdtz, E., & Regitz-Zagrosek, V. (2019). Sex differences in cardiovascular disease and the role of infections. *European Heart Journal*, 40(46), 3840–3842. <https://doi.org/10.1093/eurheartj/ehz788>.
- Regitz-Zagrosek, V., Oertelt-Prigione, S., & Prescott, E. (2020). Gender in cardiovascular diseases: Impact of infections and inflammation. *European Heart Journal*, 41(24), 2243–2246. <https://doi.org/10.1093/eurheartj/ehaa306>.
- Benjamin, E. J., Muntner, P., & Alonso, A. (2019). Heart disease and stroke statistics update. *Circulation*, 139(10), e56–e528. <https://doi.org/10.1161/CIR.0000000000000659>.
- World Health Organization. (2023). Cardiovascular diseases (CVDs). [https://www.who.int/news-room/fact-sheets/detail/cardiovascular-diseases-\(cvds\)](https://www.who.int/news-room/fact-sheets/detail/cardiovascular-diseases-(cvds)).